Welfare effects of fiscal policy in reforming the pension system

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ASSA 2018
Motivation

Longevity ↑

- Pay-As-You-Go Defined Benefits (PAYG DB) ⇒ fiscally unstable if not reformed (Feldstein: deficit +1.4pp of GDP share)
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- (Partial) funding fosters accumulation of capital
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shift of contributions to funded pillar ⇒ short run financing?
Motivation

- **in deterministic setting** horse-race between
  - efficiency
  - fiscal cost for cohorts paying for the reform
- efficiency prevails - reform welfare improving

Nishiyama & Smetters (2007, QJE) and subsequent papers: negative welfare effects of the reform

But: fiscal policy counteracts / reinforces redistribution affecting also economic efficiency (scope of distortions)

Is Nishiyama & Smetters (2007) result universal?

compare variants of fiscal closures (accompanying the reform)

introduce new fiscal closures
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- introduce new fiscal closures
Literature differs in terms of fiscal closures

Table A1: Modeling options taken in the earlier literature

<table>
<thead>
<tr>
<th>Paper</th>
<th>Problem</th>
<th>Solution</th>
<th>Soc. sec. parameters</th>
<th>Introducing</th>
<th>Fiscal closures</th>
<th>Implicit tax</th>
<th>Idiosyncratic shocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belan and Pestieau (1999)</td>
<td>aging</td>
<td>p and s</td>
<td>( \tau_I )</td>
<td>FF</td>
<td>debt</td>
<td>NO</td>
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<td>Fehr (2000)</td>
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<td>DC, DC+FF</td>
<td>debt</td>
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<td>Imrohoroglu et al. (2003)</td>
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<td>p and s</td>
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<tr>
<td>Lindbeck and Persson (2003)</td>
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<td>s</td>
<td>( \tau_I )</td>
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<td>debt</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>?</td>
<td>risk</td>
<td>PAYG DB</td>
<td>( \tau_I )</td>
<td></td>
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<td>NO</td>
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<tr>
<td>Keuschnigg et al. (2012)</td>
<td>aging</td>
<td>p</td>
<td>( \tau_I, \tau_b )</td>
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<td>debt</td>
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<td>Sanchez-Marcos and Sanchez-Martin (2006)</td>
<td>dem. uncert.</td>
<td>PAYG DB</td>
<td>( \tau_I )</td>
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<td>Verbić et al. (2006)</td>
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<td>p</td>
<td>( \tau_I )</td>
<td></td>
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<td>p</td>
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<td></td>
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<tr>
<td>Nishiyama and Smetters (2007)</td>
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<td>s</td>
<td>PRIV</td>
<td>( \tau_c )</td>
<td></td>
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<td>( \tau_I )</td>
<td></td>
<td></td>
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<td>( \tau_I )</td>
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<td>( \tau_c )</td>
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<td>Díaz-Giménez and Díaz-Saavedra (2009)</td>
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<td>M</td>
<td>( \tau_c )</td>
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<td>FF</td>
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<td>Kuhle (2010)</td>
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<td>Kumru and Thanoupolos (2011)</td>
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<td>( \tau_c )</td>
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<td>De la Croix et al. (2012)</td>
<td>aging</td>
<td>s</td>
<td>( \tau_c )</td>
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<td>Vogel et al. (2012)</td>
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<td>Wright et al. (2012)</td>
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<td>Cipriani and Makris (2012)</td>
<td>aging</td>
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<td>Bruce and Turnovsky (2013)</td>
<td>aging</td>
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<td>Börsch-Supan et al. (2014)</td>
<td>aging</td>
<td>p or s</td>
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<td></td>
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<td>Kitao (2014)</td>
<td>aging</td>
<td>p or s</td>
<td>( \tau_I, \tau_b )</td>
<td>M</td>
<td>( \tau_c )</td>
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<tr>
<td>Song et al. (2015)</td>
<td>aging</td>
<td>s</td>
<td>FF</td>
<td>debt</td>
<td></td>
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<tr>
<td>Chen et al. (2016)</td>
<td>aging, risk</td>
<td>p or s</td>
<td>( \tau_b, \tau_I )</td>
<td>COL</td>
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</table>
Literature differs in terms of fiscal closures

- Pension system parameters
  - contribution rates (20 papers)
    e.g. Kumru & Thanopoulos (2011, JPE), Bruce & Turnovsky (2013, JPE)
  - replacement rate (8 papers)
    e.g. Boersch-Supan et al. (2014, AER), Kitao (2014, RED)

⇒ Studies do not compare across fiscal closures (except for within pension system)
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  - labor tax (3 papers)
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  - debt (5 papers)
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What we do

- **Challenge the view** that in stochastic framework pension system privatization is welfare deteriorating
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- Provide a **systematic overview** of the interaction between the pension system reform and fiscal closure
- Consider **new ways of financing** the pensions system reform
  - tax on capital income
  - labor tax progression
Preview of the results

- Nishiyama & Smetters (2007) result is **NOT** universal ⇔ fiscal closure matters
- Depending on the fiscal closure in stochastic framework:
  - welfare effect of the same reform can be positive or negative
  - with political support or not
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Depending on the fiscal closure in stochastic framework:
- welfare effect of the same reform can be positive or negative
- with political support or not

Welfare gains and political support only sometimes overlap
- there are many combinations of fiscal policy that make pension system reform welfare improving
- public debt often “buys” political support for the reform (both improving and deteriorating)
Consumers

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Competitive producers

- Cobb-Douglas production function
- capital depreciation rate $d$
Pension system

Baseline scenario PAYG DB

- equal benefit for whole cohort (provides insurance)

\[ b_{J,t} = \rho \cdot w_{avg,t} \]
Pension system

Baseline scenario PAYG DB

- equal benefit for whole cohort *(provides insurance)*
  
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- indexed with payroll growth rate *(GE labor ↑ ⇒ benefits ↑)*

Reform generates a deficit in the pension system ⇒ need for fiscal closure.
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**Reform scenario partially funded DC**
- contributions go into PAYG and funded pillar: \( \tau_t = \tau_t^I + \tau_t^{II} \)
Pension system

Baseline scenario PAYG DB
- equal benefit for whole cohort \((\text{provides insurance})\)
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  b_{\bar{J},t} = \rho \cdot w_{avg,t}
  \]
- indexed with payroll growth rate \((\text{GE labor} \uparrow \implies \text{benefits} \uparrow)\)
- longevity \(\uparrow\) creates \textit{deficit} (no balancing mechanism in a system)

Reform scenario partially funded DC
- contributions go into PAYG and funded pillar: \(\tau_t = \tau^I_t + \tau^{II}_t\)
- pension accounts indexed with payroll growth rate \(\Rightarrow \text{no insurance}\)
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  b_{\bar{J},t} = \frac{\text{accrued ‘savings’}}{\text{life expectancy}_t} + \frac{\text{accrued savings}}{\text{life expectancy}_t}
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- Reform generates a deficit in the pension system ⇒ need for fiscal closure.
Government

- Collects taxes
  \[ T_t = \tau_{l,t}(1 - \tau_t)w_tL_t + \tau_{k,t}r_tA_t + \tau_{c,t}C_t + \gamma_t \sum_{j=1}^{J} N_{j,t} \]

- Finances government spending \( G_t = g_{zt} \sum_{j=1}^{J} N_{j,t} \)
- Balances pension system \( \text{subsidy}_t \)
- Services debt \( \Delta D_t = D_t - D_{t-1} \)
  \[ G_t + \text{subsidy}_t + r_tD_t = T_t + \Delta D_t \]
Fiscal closures

- Three new closures details
  - progressive labor tax ⇒ working cohorts with favorable shocks ⇒ labor supply
  - capital tax (+ debt) ⇒ cohorts with more wealth ⇒ savings & investment

- Two closures within pension system details
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In total: 9 closures (and a 81 possible combinations of fiscal policy in baseline and reform)
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Model solving

- Gauss-Seidel iterative algorithm
  - Guess an initial value for $k = K/(zL)$ and compute prices
  - Solve individual problem and aggregate it to find new $K'$ and $L'$, thus $k'$
  - Iterate until convergence

Consumer problem (backward policy function iterations)
- Implicit tax to reduce state space, Butler (2002)
- Policy function iterations with piecewise linear interpolation within period problem solved with Newton-Raphson
given initial distribution at age $j = 1$, transition matrix for idiosyncratic productivity and the policy functions compute the distribution in any successive age $j$.
aggregation done with Gaussian quadrature

Transition path, goes between the initial and final steady state
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- Transition path, goes between the initial and final steady state
Calibration to replicate 2015 US economy

Preferences

- Preference for leisure $\phi$ matches average hours 33%
- Discounting rate $\delta$ matches interest rate 4%

Idiosyncratic productivity shock based on Kruger and Ludwig (2013):

Persistence $\varrho = 0.95$

Variance $\sigma_\eta = 0.375$

Pension system

Replacement rate $\rho$ matches benefits as % of GDP 5.2%

Contribution rate balances pension system in the initial steady state

Retirement age equal 65 ($\bar{\eta} = 9$)

Taxes $\{\tau_c, \tau_l, \tau_k\}$ match revenue as % of GDP $\{9.2\%, 3.8\%, 3.6\%\}$

Depreciation rate $d$ matches investment rate of 25%
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**Demography** is based on the projection by The United Nations.

![Graphs showing number of 20-year-olds and mortality rates](image)
Reform: gradually replace PAYG DB ...

... with a partially funded define contribution (DC)

Cohorts in DB

1960

Date of birth

Cohorts with initial capital

1995

Reform date

Cohorts in DC

2015
Contents
Baseline: PAYG DB with aging and thus deficit

Adjustment in pension parameters
contribution rate ↑ from 7.8% to 9%
tax on pensions ↓ from 0.0% to 17.3%

Adjustment in fiscal parameters
pension system deficit ↑ by 1pp of GDP
Reform: partially funded DC

Pension system deficit temporary ↑ from 0% to 2% of GDP
**Major effects of the reform**

<table>
<thead>
<tr>
<th>Links pensions to contributions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Efficiency gain</td>
</tr>
<tr>
<td>2. Loss of insurance</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Necessitates fiscal adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Affects degree of efficiency gain</td>
</tr>
<tr>
<td>2. Affects degree of insurance loss</td>
</tr>
</tbody>
</table>

What happens within each experiment?

1. Run no policy reform scenario ⇒ baseline
2. Run policy reform scenario ⇒ reform
3. For each cohort compare utility, compensate the losers from the winners
4. If net effect positive ⇒ reform efficient
Compare two different tax closures, $\tau_c$ and $\tau_k$

$\tau_k$ has larger gain than $\tau_c$ towards the end,

$\rightarrow$ positive overall welfare effect
## Welfare effect - transition

<table>
<thead>
<tr>
<th>Fiscal closure</th>
<th>$\tau_k$</th>
<th>$d\tau_k$</th>
<th>$d\tau_k$ prog.</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tau_k$</td>
<td>0.57</td>
<td></td>
<td></td>
<td>$\tau$</td>
</tr>
<tr>
<td>$d\tau_k$ prog.</td>
<td>0.54</td>
<td></td>
<td></td>
<td>$\tau_b$</td>
</tr>
<tr>
<td>$\tau$</td>
<td>0.02</td>
<td></td>
<td></td>
<td>$\tau_c$</td>
</tr>
<tr>
<td>$\tau_l$</td>
<td></td>
<td></td>
<td></td>
<td>$d\tau_c$</td>
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<tr>
<td>$d\tau_l$</td>
<td></td>
<td></td>
<td></td>
<td>$d\tau_l$</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Reform</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tau$</td>
</tr>
<tr>
<td>$\tau_b$</td>
</tr>
<tr>
<td>$\tau_c$</td>
</tr>
<tr>
<td>$d\tau_c$</td>
</tr>
<tr>
<td>$\tau_l$</td>
</tr>
<tr>
<td>$d\tau_l$</td>
</tr>
</tbody>
</table>
### Welfare effect - transition

#### Fiscal closure

<table>
<thead>
<tr>
<th></th>
<th>$\tau_k$</th>
<th>$d\tau_k$</th>
<th>prog.</th>
<th>$\tau$</th>
<th>$\tau_b$</th>
<th>$\tau_c$</th>
<th>$\tau_l$</th>
<th>$d\tau_c$</th>
<th>$d\tau_l$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tau_k$</td>
<td>0.57</td>
<td>0.56</td>
<td>1.01</td>
<td>0.59</td>
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<td>0.65</td>
<td>0.66</td>
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<tr>
<td>$d\tau_k$</td>
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<td>0.54</td>
<td>0.99</td>
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<td>0.63</td>
<td>0.63</td>
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<td>0.64</td>
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<tr>
<td>prog.</td>
<td>-0.45</td>
<td>-0.45</td>
<td>0.02</td>
<td>-0.13</td>
<td>-0.07</td>
<td>-0.35</td>
<td>-0.35</td>
<td>-0.36</td>
<td>-0.34</td>
</tr>
</tbody>
</table>

#### Reform

<table>
<thead>
<tr>
<th></th>
<th>$\tau$</th>
<th>$\tau_b$</th>
<th>$\tau_c$</th>
<th>$\tau_l$</th>
<th>$d\tau_c$</th>
<th>$d\tau_l$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tau_k$</td>
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<td>-0.12</td>
<td>0.35</td>
<td>0.09</td>
<td>0.14</td>
<td>-0.03</td>
</tr>
<tr>
<td>$\tau_b$</td>
<td>-0.15</td>
<td>-0.14</td>
<td>0.33</td>
<td>0.07</td>
<td>0.13</td>
<td>-0.05</td>
</tr>
<tr>
<td>$\tau_c$</td>
<td>-0.14</td>
<td>-0.14</td>
<td>0.33</td>
<td>0.11</td>
<td>0.17</td>
<td>-0.04</td>
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<tr>
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<td>-0.16</td>
<td>-0.16</td>
<td>0.31</td>
<td>0.09</td>
<td>0.15</td>
<td>-0.07</td>
</tr>
<tr>
<td>$\tau_l$</td>
<td>-0.46</td>
<td>-0.46</td>
<td>0.01</td>
<td>-0.11</td>
<td>-0.03</td>
<td>-0.36</td>
</tr>
<tr>
<td>$d\tau_l$</td>
<td>-0.45</td>
<td>-0.45</td>
<td>0.01</td>
<td>-0.1</td>
<td>-0.02</td>
<td>-0.36</td>
</tr>
</tbody>
</table>

% of consumption in the reform scenario which you are willing to give up to ensure that the reform take place

- $\tau_k$ is always a good idea
- little effect of debt on welfare
- prog. (almost) always better then $\tau_l$ in the reform
## Welfare effect - final steady state

<table>
<thead>
<tr>
<th>Fiscal closure</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\tau_k)</td>
<td>(d\tau_k)</td>
</tr>
<tr>
<td>(\tau_k)</td>
<td>0.95</td>
</tr>
<tr>
<td>(d\tau_k)</td>
<td>0.95</td>
</tr>
<tr>
<td>\text{prog.}</td>
<td>0.65</td>
</tr>
</tbody>
</table>

\(\tau_k\) brings large welfare improvement. No long run effect of debt.

\(\tau\) always better than \(\tau_l\).
Welfare effect - final steady state

| Fiscal closure | \( \tau_k \) | \( d\tau_k \) | prog. | | Baseline | \( \tau \) | \( \tau_b \) | \( \tau_c \) | \( \tau_l \) | \( d\tau_c \) | \( d\tau_l \) |
|---------------|--------------|-------------|--------|-------------------------------|--------|--------|--------|--------|--------|--------|
| \( \tau_k \)  | 0.95         | 0.95        | 1.36   | 1.09                          | 0.85   | 1.02   | 1.02   | 1.02   | 1.02   | 1.02   |
| \( d\tau_k \) | 0.95         | 0.95        | 1.36   | 1.09                          | 0.85   | 1.02   | 1.02   | 1.02   | 1.02   | 1.02   |
| prog.         | 0.24         | 0.24        | 0.65   | 0.58                          | 0.43   | 0.31   | 0.31   | 0.31   | 0.31   | 0.31   |
| \( \tau \)    | 0.47         | 0.47        | 0.88   | 0.71                          | 0.54   | 0.54   | 0.53   | 0.54   | 0.53   | 0.53   |
| \( \tau_b \)  | 0.47         | 0.47        | 0.88   | 0.71                          | 0.54   | 0.54   | 0.53   | 0.54   | 0.54   | 0.53   |
| \( \tau_c \)  | 0.34         | 0.34        | 0.75   | 0.65                          | 0.49   | 0.41   | 0.40   | 0.41   | 0.41   | 0.4   |
| \( \tau_l \)  | 0.20         | 0.20        | 0.61   | 0.56                          | 0.43   | 0.27   | 0.26   | 0.27   | 0.26   | 0.26   |
| \( d\tau_c \) | 0.34         | 0.34        | 0.75   | 0.65                          | 0.49   | 0.41   | 0.40   | 0.41   | 0.41   | 0.4   |
| \( d\tau_l \) | 0.20         | 0.20        | 0.61   | 0.56                          | 0.43   | 0.26   | 0.26   | 0.26   | 0.26   | 0.26   |

- \( \tau_k \) brings large welfare improvement
- no long run effect of debt
- prog. always better that \( \tau_l \)
Welfare effects: why public debt can help gaining political support?

- It helps pensioners (who gain anyway)
- Young always loose (→ are against the reform)
- With debt we sway some working who remain in the old system → majority
Welfare effect – $\tau_k$

Why debt can help gain political support
Welfare effect - transition - $\tau_k$ & debt + $\tau_k$

Why debt can help gain political support
Why debt can help gain political support
### Political support

**green area** denotes welfare gain, **green font** denotes political support

<table>
<thead>
<tr>
<th>Fiscal closure</th>
<th>( \tau_k )</th>
<th>( d\tau_k )</th>
<th>( \text{prog.} )</th>
<th>Baseline</th>
<th>( \tau )</th>
<th>( \tau_b )</th>
<th>( \tau_c )</th>
<th>( \tau_l )</th>
<th>( d\tau_c )</th>
<th>( d\tau_l )</th>
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<tr>
<td>( \tau_l )</td>
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</tbody>
</table>
Nishiyama & Smetters, 2007: stochastic vs deterministic?

Compare the effects of pension system reform in a stochastic and deterministic framework
Nishiyama & Smetters, 2007: stochastic vs deterministic?

Compare the effects of pension system reform in a stochastic and deterministic framework

- large role for the insurance motive *per se*
- but there are closures with positive outcomes despite stochastic setup
Decomposition

- Capital tax: the highest welfare gain due to efficiency
- Progression: the smallest welfare loss due to insurance
Decomposition

- capital tax: the highest welfare gain due to efficiency
- progression: the smallest welfare loss due to insurance
Nishiyama & Smetters, 2007: stochastic vs deterministic?
Nishiyama & Smetters, 2007: stochastic vs deterministic?
Conclusions

- Social security reform requires fiscal adjustment
- Fiscal closures redistribute and affect efficiency, therefore matter a lot (unnoticed in earlier literature)
- Loss of Insurance important but not necessarily decisive for evaluation of (partial) privatization
- Preferred policy options
  - Debt closures: allow to smooth the transition burden on more cohorts
  - Tax on capital income
- Good but never favored policy options
  - Adjustment in pensions
  - Labor tax progression (puzzling)
Questions or suggestions?
Thank you!

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New fiscal closures

- capital tax tax, $\tau_{k,t}$

$$T_t = \tau_{l,t}(1 - \tau_t)w_t L_t + \tau_{k,t}r_tA_t + \tau_{c,t}C_t + \gamma_t \sum_{j=1}^{J} N_{j,t}$$

$$G_t + \text{subsidy}_t + r_tD_t = T_t + \Delta D_t$$

- smoothing tax adjustments with public debt
- part of the costs of the reform shifted to the future generations
- fiscal rule

$$\tau_{k,t} = (1 - \varrho)\tau_{k,\text{final}} + \varrho\tau_{k,t-1} + \varrho D \left( \left( \frac{D_t}{Y_t} \right) - \left( \frac{D}{Y} \right)^{\text{final}} \right)$$

- debt in the final steady state the same as in the initial steady state.
Fiscal new closures

- $tr_1$ is the lowest income threshold
- $tr_n$ is the highest income threshold
- $n$ is the number of income brackets
- $m$ is a tax multiplier such that $\tau_{l,t}^i = \tau_{l,t}^0 * m^i$
Fiscal new closures

- $tr_1$ the lowest income threshold
- $tr_n$ is the highest income threshold
- $n$ is the number of income brackets
- $m$ is a tax multiplier such that $\tau^i_{l,t} = \tau^0_{l,t} \times m^i$
- Income threshold is multiple of average labor income, $(1 - \tau_t)w_t\bar{l}_t$.
- In the initial steady state $m = 1$
- In the transition path $m = 1.15$ and $n = 4$
Fiscal closures new in the literature

Total gross labor income \((1 - \tau_t) w_t L_t\) is a sum of \(n + 1\) components: earnings taxed by one of \(n + 1\) tax rate.

\[
L^0_t = \sum_{j=1}^{J} N_{j,t} \int_{\Omega} \min(\omega_j(t, s_j,t) l_{j,t}(s_j,t), tr_1) d\mathbb{P}_{j,t}
\]

\[
L^i_t = \sum_{j=1}^{J} N_{j,t} \int_{\Omega} \max(\min(\omega_j(t, s_j,t) l_{j,t}(s_j,t), tr_i), tr_i - tr_i-1), 0) d\mathbb{P}_{j,t} \forall i = 1, ..., n
\]

\[
\tau^0_{l,t} = \frac{G_t + subsidy_t + \Delta D_t - \gamma_1 \sum_{j=1}^{J} N_{j,t} - \tau_{c,1} C_t - \tau_{k,1} r_t A_t - \sum_{i=0}^{n} L^i_t \tau^i_l}{\sum_{i=0}^{n} L^i_t}
\]

\[
\tau^i_{l,1} = m^i * \tau^0_{l,1}
\]
Fiscal closures within pension system

To keep pension system balanced government may adjust:

- contribution rate \( \tau \)
- benefits \( b_j \) (as a tax on benefits)

\[
\sum_{j=J_t}^{J} N_{j,t} (1 - \tau_{b,t}) b_{j,t} = \tau_t \bar{w}_t L_t \quad \text{and} \quad \text{subsidy}_t = 0
\]
Fiscal closures outside pension system, \( \text{subsidy}_t \neq 0 \)

- consumption tax, \( \tau_{c,t} \)
- labor tax, \( \tau_{l,t} \)

\[
T_t = \tau_{l,t}(1 - \tau_t)w_tL_t + \tau_{k,t}r_tA_t + \tau_{c,t}C_t + \gamma_t \sum_{j=1}^{J} N_{j,t}
\]

\[
G_t + \text{subsidy}_t + r_tD_t = T_t + \Delta D_t
\]

- smoothing tax adjustments with public debt
- part of the costs of the reform shifted to the future generations
- fiscal rule \( \forall \text{tax} \in \{l, c\} \)

\[
\tau_{\text{tax},t} = (1 - \varrho)\tau_{\text{tax}}^{\text{final}} + \varrho\tau_{\text{tax},t-1} + \varrho D \left( \left( \frac{D}{Y} \right)_t - \left( \frac{D}{Y} \right)^{\text{final}} \right)
\]

- debt in the final steady state the same as in the initial steady state
Profile of average consumption for $\tau_k$ closure

in line with Gourinchas & Parker (2002, Econometrica)
Profile of average labor for $\tau_k$ closure

- Initial steady state
- Baseline final steady state
- Reform final steady state
Profile of average savings for $\tau_k$ closure

- initial steady state
- baseline final steady state
- reform final steady state
$\tau_k$  

$\text{debt} + \tau_k$  

$\text{progression}$  

$\tau$  

$\tau_l$  

$\text{debt} + \tau_l$  

$\tau_b$  

$\tau_c$  

$\text{debt} + \tau_c$  

$\tau_c$
$\tau_k$  

$\text{debt } + \tau_k$  

$\text{progression}$

$\tau$  

$\tau_l$  

$\text{debt } + \tau_l$  

$\tau_b$  

$\tau_c$  

$\text{debt } + \tau_c$